



## **DEPARTMENT OF AGRICULTURE**

### **Agricultural Marketing Service**

**[Doc. No. AMS-LPS-16-0060-0001]**

#### **United States Standards for Grades of Carcass Beef**

**AGENCY:** Agricultural Marketing Service, USDA

**ACTION:** Notice; request for comments.

**SUMMARY:** The Agricultural Marketing Service (AMS) of the U.S. Department of Agriculture (USDA) is proposing amendments to the United States Standards for Grades of Carcass Beef (beef standards). Specifically, AMS is proposing amendments to the beef standards that would allow dentition and documentation of actual age as additional methods of classifying maturity of carcasses presented to USDA for official quality grading. Currently, the standards include only skeletal and muscular evidence as a determination of classifying maturity of carcasses for the purposes of official USDA quality grading. Official USDA quality grading is used as an indication of meat palatability and is a major determining factor in live cattle and beef value.

**DATES:** Submit comments on or before [INSERT DATE 60 DAYS FROM DATE OF PUBLICATION IN THE FEDERAL REGISTER].

**ADDRESSES:** Interested persons are invited to submit comments electronically at <https://www.regulations.gov>. Written comments may be sent to: Beef Carcass Revisions, Standardization Branch, Quality Assessment Division (QAD); Livestock, Poultry, and Seed Program (LPS), AMS, USDA; 1400 Independence Avenue, SW.; Room 3932-S, STOP 0258; Washington, DC 20250-0258. Comments may also be e-mailed to [beefcarcassrevisions@ams.usda.gov](mailto:beefcarcassrevisions@ams.usda.gov). Submitted comments will be available for public inspection at <https://www.regulations.gov>, or during regular business hours at the above

address. Please be advised that the identity of the individuals or entities submitting the comments will be made public on the Internet at the address provided above.

**FOR FURTHER INFORMATION CONTACT:** Bucky Gwartney, International Marketing Specialist, Standardization Branch, QAD, LPS, AMS, USDA; 1400 Independence Avenue, SW.; Room 3932-S, STOP 0258; Washington, DC 20250-0258; phone (202) 720-1424; or via e-mail at [Bucky.Gwartney@ams.usda.gov](mailto:Bucky.Gwartney@ams.usda.gov).

**SUPPLEMENTARY INFORMATION:**

Section 203(c) of the Agricultural Marketing Act of 1946, as amended (7 U.S.C. 1621 et seq.), directs and authorizes the Secretary of Agriculture “to develop and improve standards of quality, condition, quantity, grade, and packaging and recommend and demonstrate such standards in order to encourage uniformity and consistency in commercial practices.” AMS is committed to carrying out this authority in a manner that facilitates the marketing of agricultural commodities. While the beef standards do not appear in the Code of Federal Regulations, they—along with other official standards—are maintained by USDA at <https://www.ams.usda.gov/grades-standards>. Copies of official standards are also available upon request. To propose changes to the beef standards, AMS utilizes the procedures it published in the August 13, 1997, Federal Register, and that appear in 7 CFR part 36.

**Background**

The beef standards and associated voluntary, fee-for-service beef grading service program are authorized under the Agricultural Marketing Act of 1946, as amended. The primary purpose of official USDA grade standards is to divide the population of a commodity into uniform groups (of similar quality, yield, value, etc.) to facilitate

marketing. The USDA's voluntary, fee-for-service grading programs are designed to provide an independent, objective determination as to whether a given product is in conformance with the applicable official standard. When beef is voluntarily graded to the beef standards under the grading service, the official grade consists of a quality grade and/or a yield grade.

The quality grades are intended to identify differences in the palatability or eating satisfaction of cooked beef principally through the characteristics of marbling and physiological maturity groupings. As noted in the standards referenced above, the principal official USDA quality grades for young (maturity groups "A" and "B") cattle and carcasses are Prime, Choice, and Select, in descending order in terms of historic market value. USDA recognizes that the beef standards must be relevant in order to be of greatest value to stakeholders and, therefore, recommendations for changes in the standards may be initiated by USDA or by interested parties at any time to achieve that goal.

For beef, USDA quality grades provide a simple, effective means of describing product that is easily understood by both buyers and sellers. By identifying separate and distinct segments of beef, grades enable buyers to obtain the particular kind of beef that meets their individual needs. For example, certain restaurants may choose to only sell officially graded USDA Prime beef so as to provide their customers with a product that meets a very consistent level of overall palatability. At the same time, grades are important in transmitting information to cattle producers to help ensure informed production, feeding, and marketing decisions are made. For example, the market preference and price paid for a particular grade of beef is communicated to cattle

producers so they can adjust their production accordingly. In such a case, if the price premium being paid for a grade, such as USDA Prime beef, merits producers making the investments required in cattle genetics and feeding to produce more USDA Prime beef, such marketing decisions can be made with justification.

### **Current Process for Determining Maturity**

Since its inclusion in the beef standards, physiological maturity based on skeletal and muscular evidence has been the means for establishing age of animals in both marketing standards and in research. USDA graders examine signs of physiological maturity (e.g., size, shape, and ossification of the bones and cartilages—especially the split chine bones—and color, texture, and firmness of the lean flesh) in order to assign a maturity grouping. Although never intended to be a definitive method to determine the chronological age of cattle at the time of slaughter and instead utilized to predict beef palatability, the maturity groupings have historically been roughly correlated to different age ranges and categories: maturity grouping A was correlated with beef from cattle between 9 and 30 months of age (MOA) at time of slaughter, maturity grouping B was correlated with beef from cattle between 30 and 42 MOA at time of slaughter, maturity grouping C was correlated with beef from cattle between 42 and 72 MOA at time of slaughter, maturity grouping D was correlated with beef from cattle between 72 and 96 MOA at time of slaughter, and maturity grouping E was correlated with beef from cattle more than 96 MOA at time of slaughter. However, these are rough approximations that are influenced by other factors including sex, nutrition, growth promotant administration, reproductive status, breed, and a variety of other environmental factors. Therefore, cattle

that are younger than 30 MOA may have a physiological maturity grouping of B or greater due to the factors listed above.

Generally, A-maturity carcasses are eligible for Prime, Choice, Select, and Standard quality grades; B-maturity carcasses are eligible for Prime, Choice, or Standard; and C-, D-, or E-maturity carcasses are eligible for Commercial, Utility, Cutter, or Canner. In most fed beef plants, carcasses that fit the C-, D-, or E-maturity categories (often referred to as “hard bones”) are not presented for USDA grading.

The beef standards have had past revisions made to the maturity grouping requirements, and these revisions resulted in classifications that were designed to reduce the variability of eating quality within the grades. The most recent such change occurred in 1997 when certain carcasses from the B-maturity grouping were no longer eligible for the USDA Select quality grade. The official standards have never relied upon any other indicator besides physiological maturity to determine maturity grouping or the resulting USDA quality grade. This was primarily because the use of physiological maturity was not intended to be used to predict the age of an animal at time of slaughter but rather the resulting palatability of the meat.

Many years of research have demonstrated a correlation between physiological maturity and beef palatability, and the factors affecting the physiological maturity of a beef animal are numerous. It is well-documented that elevated levels of estrogen, found in heifers and heiferettes (females that have calved once), result in advanced skeletal ossification. Estrogen is also higher in those animals being administered growth implants containing estrogen and estrogen-like compounds and possibly those animals fed and exposed to naturally occurring estrogens in their diet. Animals having an elevated

exposure to estrogen are much more likely to result in B- or C-maturity carcasses, and this advanced skeletal maturity is more prevalent the closer the animal is to 30 MOA.

The scientific literature also indicates that the meat in younger cattle contains immature and soluble collagen that when cooked does not negatively impact the tenderness of the product. As an animal matures, the collagen will become more mature and have more thermally stable cross-links, resulting in a tougher product. However, when grain-finished cattle are evaluated at various ages (12 to 35 months) and skeletal maturities (A to C), the resulting differences in tenderness are minimal. Scientific studies support this phenomenon, explained by the faster turnover of both the muscle fibers and the connective tissue within the animal due to faster growth and higher concentrate diets. An overview of many of these factors is discussed by Tatum, 2011.<sup>1</sup>

## **Dentition**

Although not used as part of the voluntary grading process, dentition has been used in the U.S. since 2004 by the USDA's Food Safety and Inspection Service (FSIS) in all federally inspected plants to determine whether an animal is less than or older than 30 MOA. FSIS Directive 6100.4 explains that "[i]nspection program personnel are to consider cattle to be 30 months and older when the examination of the dentition of the animal shows that at least one of the second set of permanent incisors (I2) has erupted above the gum line." Cattle older than 30 MOA must have certain specified risk materials, such as the vertebral column, removed from their carcasses before the sale of the resulting beef cuts. In addition to the visual inspection of permanent incisors, FSIS personnel will accept documentation showing the actual age of the animal. Age

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<sup>1</sup> J.D. Tatum, 2011. Animal Age, physiological maturity, and associated effects on beef tenderness. White Paper funded by the Cattlemen's Beef Promotion and Research Board.

verification involves providing the proper paperwork or other proof of an animal's actual age (e.g., less than 30 MOA) and is also used for a variety of purposes, including meeting foreign market requirements for U.S. beef from cattle under a certain age.

Current research has indicated that carcasses from grain-fed steers and heifers that are identified as less than 30 MOA based on dentition are similar in palatability to A-maturity carcasses determined via physiological maturity and thus could be classified A-maturity for grading purposes even though the physiological maturity characteristics of B- or older maturity groupings may be present. When comparisons involve grain-finished steers and heifers that are less than 30 MOA, the age of the animal has been shown to have little effect on beef tenderness. In addition, numerous studies have evaluated the relationship between the skeletal maturity of an animal and its dentition pattern. In two experiments, described by Lawrence *et al.*, 2001, 1,464 cattle were evaluated for physiological maturity and dentition characteristics.<sup>2</sup> These studies showed that 97.5 percent of cattle with 2 permanent incisors (the cutoff point for less than 30 MOA) were classified as A-maturity carcasses. In that study, the authors suggest that dentition is a more accurate determinant of carcass maturity, although they have no evidence that dentition is better able to predict palatability. This is supported by other research showing that dentition is more closely related to actual chronological age than is physiological maturity.

Two recent studies funded by the Cattlemen's Beef Promotion and Research Board evaluated the relationship between eating quality and the skeletal maturity of carcasses that were classified by dentition as either less than 30 MOA or greater than 30

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<sup>2</sup> Lawrence, T.E., J.D. Whatley, T.H. Montgomery and L.J. Perino. 2001. A comparison of the USDA ossification based maturity system to a system based on dentition. *Journal of Animal Science*, 79:1683-1690.

MOA. The first study<sup>3</sup> (Acheson *et. al.*, 2014) sampled 450 grain-finished steer and heifer carcasses classified as less than 30 MOA through dentition, with varying skeletal maturity and marbling scores. Trained sensory panels and slice shear force (SSF) testing were conducted and neither analysis determined a difference between steaks from the A-maturity versus the B- through C-maturity carcasses. Marbling categories were effective in stratifying carcasses according to differences in tenderness and juiciness. Results from that study suggest A-C-maturity carcasses have similar sensory and SSF scores when they originate from grain-finished cattle classified as less than 30 MOA by dentition.

The second study<sup>4</sup> (Semler *et. al.*, 2016) evaluated the tenderness of steaks from 600 steer and heifer carcasses that varied in marbling, skeletal maturity, and age by dentition. Tenderness was also evaluated by trained sensory panels and SSF testing. The results were consistent with those from the first study and showed that the tenderness between USDA maturity classifications (A versus B-D) was not different within dental age (less than 30 MOA or greater than 30 MOA). Steaks from carcasses greater than 30 MOA did have more intense grassy and bloody/serum flavors and decreased tenderness within the slight degree of marbling group. As in the first study, the degree of marbling was effective in stratifying carcasses according to differences in tenderness and juiciness.

### **Request for a Change to the Beef Standards**

On April 13, 2016, representatives from the National Cattlemen's Beef Association, the National Association of State Departments of Agriculture, the U.S. Meat

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<sup>3</sup> Acheson, R.J., Woerner, D.R., and Tatum, J.D. 2014. Effects of USDA carcass maturity on sensory attributes of beef produced by grain-finished steers and heifers classified as less than 30 months old using dentition. *Journal of Animal Science*, 92:1792-1799.

<sup>4</sup> Semler, M.L, D.R. Woerner, K.E. Belk, K.J. Enns, and J.D. Tatum. 2016. *Journal of Animal Science*, 94:2207-2217. Effects of United States Department of Agriculture carcass maturity on sensory attributes of steaks produced by cattle representing two dental age classes.



Export Federation, and the American Farm Bureau Federation petitioned USDA to amend the beef standards. The petition to amend the beef standards (the petition) seeks to amend them by allowing age verification or dentition-based assessment to determine carcass maturity in fed steers and heifers. Both the petition and associated research are available at <https://www.ams.usda.gov/grades-standards/beef-request-for-comments>.

In consideration of the body of research, the petition requested that USDA revise the beef standards by adding the following language to section 54.104(k) of the beef standards that describes the skeletal maturity:

Carcasses of grain-fed steers and heifers determined to be less than 30 months old either by dentition (assessed at the time of slaughter under the supervision of USDA-FSIS) or by documentation of actual age (verified through a USDA Process Verified Program or USDA Quality System Assessment) are included in the youngest maturity group for carcasses recognized as “beef” (A and B maturity) regardless of skeletal evidences of maturity.

The petition stated that approximately 7.2 percent of cattle classified as less than 30 months of age exhibit premature skeletal ossification, and so rather than qualifying as A-maturity (the youngest maturity classification in the beef standards), they qualify as B-maturity or older and are subject to discounts that reduce the overall value of the carcass.

AMS was also provided a large data set from a recent study of beef packing plant slaughter and performed a statistical and economic analysis on the data to determine the possible impact should the proposed change to the beef standards be adopted. The results of this review were published in a May 19, 2016, document, “Economic Assessment of the Request to Modernize the U.S. Standards for Grades of Carcass Beef”, and is

available at the aforementioned website. The study period ranged from the beginning of May 2014 through the end of April 2015. Extrapolating the study data across the total population of cattle graded each year by AMS—approximately 21 million—resulted in the following:

- Seventy-two percent were slaughtered in facilities participating in the study;
- Ninety-seven percent were found to be less than 30 MOA using dentition;
- Less than 3 percent (2.8) were found to be equal to or greater than 30 MOA;
- Less than 2 percent (1.68) were deemed to be age-discounted when using skeletal ossification as the measure of maturity grouping; and
- Less than one-half of 1 percent of the total cattle graded were age-verified.

According to the study, had there been an allowance to use dentition as a means to override physiological characteristics of advanced maturity grouping, as was proposed, roughly an additional 1 percent of those cattle would have been eligible for grading. Of these cattle, 4.5 percent would have been graded Prime, 63.6 percent Choice, and 31.9 percent Select. Within the Choice category, 24.4 percent of all newly graded carcasses would have been placed in the top two-thirds Choice category (branded Choice programs), and 39.2 percent of all added carcasses would have been placed in the bottom of the Choice category. In addition, lean and skeletal maturity requirements are referenced throughout many of the current USDA Certified Beef Programs and the General Schedules. Upon request, USDA provides certification of meat carcasses for a number of marketing programs that make claims concerning breed and carcass

characteristics. If the proposed changes to the beef standards are made, users of these certified programs should evaluate their specifications closely and recommend any needed changes to USDA.

The grade composition of the carcasses being added by using dentition as a measure of age was not much different than the grade composition of carcasses graded using physiological maturity, and overall, these data show an increase of 1.05 percent for Prime beef, 0.91 percent for Choice, and 1.29 percent for Select. According to calculations made from wholesale beef elasticity, wholesale beef prices could decline between 1 to 1.5 percent for each of the grade categories as a result of the increased supply of graded beef. Using this data, AMS found a net gain to producers of nearly \$55 million, primarily due to reduced hard bone discounts for quality grade maturity grouping done by the current physiological maturity approach alone.

### **Previous Solicitation for Comments**

This information was published by USDA in a Notice in the Federal Register (81 FR 57877) on August 24, 2016, which sought public comment on whether or not to amend the beef standards. AMS received 236 total comments. Of those comments, 179 commenters favored revising the beef standards to include dentition and documented age as additional methods for maturity classification. There were 53 commenters who did not support making the changes. Two comments were submitted in duplicate and one comment was submitted in triplicate; each of these respective submissions was counted only once. It is noteworthy that 160 of the 179 favorable comments were the same form letter and were from producers. Comments can be viewed at <https://www.regulations.gov/document?D=AMS-LPS-16-0060-0001>.

The vast majority of comments were received from the producer segment of the industry. Commenters who supported the changes cited an anticipated increase in the number of carcasses that would qualify for USDA grades of Prime, Choice, and Select without a significant reduction in palatability for those grades; the anticipated profitability producers would gain by having carcasses grade or grade higher; and support for the science-based Cattlemen's Beef Promotion and Research Board-funded research. Many agricultural associations, which represent a majority of cattle producers, provided favorable comments in support of the changes. In addition, most major packing companies provided positive comments in support of the changes. The potential increase in Prime and Choice carcasses, along with premiums to the producers, were the primary factors cited for their support.

Commenters opposed to changing the beef standard identified various issues of concern, and these are further discussed below. Although there were 53 individual comments that did not support a revision to the beef standards, many responses raised multiple issues. Therefore, as we examine each category of concern, the total figures mentioned will exceed a sum of 53. Seventeen commenters believed the populations in the referenced studies were too small. In response, AMS has determined that all studies referenced herein—including those that found that carcasses exhibiting advanced skeletal maturity when determined by dentition to be under 30 MOA produced meat that was as palatable in taste tests as meat produced from carcasses that did not exhibit signs of advanced skeletal maturity—were peer-reviewed and adequately designed to answer the study objectives and hypotheses. Statistical significance and statistical power of the test

will in fact increase with an increased sample size, in small increments, but add significant costs.

There were 24 commenters who questioned the value of dentition in predicting age, and 1 commenter pointed out that the beef standards are not designed to predict age, but instead palatability. In response, AMS notes that recent research suggests that dentition is a more accurate determinant of carcass maturity and is more closely related to actual chronological age than is USDA physiological maturity. As briefly discussed above, studies by Lawrence showed that 97.5 percent of cattle with 2 permanent incisors (the cutoff point for less than 30 MOA) were classified as A-maturity carcasses.

One commenter suggested that a change to the beef standards was not warranted given the relatively small percentage of cattle (and subsequent carcasses) affected by the change. While the economic study performed by USDA shows an approximate potential increase of 1 percent in the Choice and Prime categories, AMS believes this is a significant value proposition for both the beef production and processing sectors. USDA is not proposing this change because of the number of cattle that will be affected or the economic benefit. Instead, USDA is proposing to revise the beef standards because current scientific research has presented another acceptable means for determining the maturity of a beef carcass.

Thirteen commenters expressed concern about the dentition process overseen by FSIS and the perceived lack of training for the employees responsible for this procedure. FSIS has clear guidelines and procedures for the evaluation of dentition on cattle, and this procedure has been ongoing for many years with little to no concerns being raised by domestic or international users of U.S. beef products. Several of these commenters also

suggested that, while they believe FSIS is properly overseeing the dentition process through trained plant personnel, they believe AMS must have involvement in the process if that dentition determination will ultimately become a factor in the application of a voluntary USDA grade. In response to this concern, AMS would require that plants provide their procedures for marking and identification of cattle greater than 30 MOA. AMS would also verify these procedures are being adhered to through a Quality Systems Assessment audit or other means. AMS is also proposing a procedure and change to the standard that would allow the AMS grader to refrain from grading an under-30-MOA carcass that exhibits advanced skeletal maturity (e.g., D- and E-skeletal maturity). While this may occur infrequently, providing a procedure for AMS graders to evaluate advanced skeletal carcasses that are identified as under 30 MOA protects the grading system and ensures that carcasses exhibiting advanced skeletal maturity never qualify for Prime, Choice, Select, or Standard.

Twenty commenters suggested that these changes would cheapen U.S. beef. It is important to note that the majority of grain-finished cattle are harvested at 12 to 24 MOA and usually produce A-maturity beef. In other words, the vast majority of cattle offered for grading will not be affected at all by this proposed change. That said, a percentage of carcasses that today are evaluated as B- or C-maturity but are produced from cattle under 30 MOA would be eligible for grading under the proposed system. Based on AMS's estimates outlined in "Economic Assessment of the Request to Modernize the U.S. Standards for Grades of Carcass Beef," roughly an additional 1 percent of cattle would be eligible for grading. The research outlined here does not show any trends towards an inferior product being produced if dentition is implemented.

Lastly, 15 commenters raised concerns over how the proposed changes would be implemented and differ from current practices. Implementing the use of dentition in plants for the determination of beef quality grades would require minimal changes to an AMS grader's day-to-day activities. There may be plant-specific requirements and changes needed regarding the identification procedures for carcasses less than 30 MOA and greater than 30 MOA, but these procedures are currently being carried out in-plant. Carcasses deemed less than 30 MOA would be sorted and the grader would then perform his or her normal marbling assessment to apply the final quality grade. Consistent with the current practices, any carcasses deemed greater than 30 MOA would be marked by the plant and graded by an AMS grader using skeletal and lean characteristics to determine maturity and then marbling.

### **Summary of Proposed Changes to the Beef Standards**

In consideration of the approximately three-fourths of commenters who supported revising the beef standards, as well as the research supporting their modernization, USDA is issuing this Notice outlining proposed changes. These changes would allow dentition and documentation of actual age to be used to classify beef carcasses as A-maturity and determine eligibility for all quality grade classifications, with the exception of those carcasses exhibiting advanced skeletal maturity traits (as described for D- and E-maturity).

USDA proposes to provide additional oversight of the dentition process used to classify carcasses as either less than 30 MOA or greater than 30 MOA. FSIS approves plant personnel to examine the dentition and FSIS inspectors to monitor the process to ensure carcasses greater than 30 MOA have been correctly identified. However, because

this process would now be instrumental to the subsequent application of a USDA quality grade, AMS personnel must have knowledge of the process including marking and identification techniques for cattle greater than 30 MOA. AMS would review this process on a regular basis through an existing Quality System Assessment audit or other means. In many beef packing plants, AMS already reviews the dentition process as part of an export verification audit and the applicant makes these procedures available to the USDA grader.

USDA proposes to allow carcasses identified as less than 30 MOA through dentition or actual documented age (through an approved USDA Process Verified Program or Quality System Assessment Program) to qualify for the USDA Prime, Choice, Select and Standard grades, regardless of skeletal and lean characteristics. This proposal means that for carcasses deemed less than 30 MOA, the amount and distribution of marbling will become the primary characteristics for determining the final USDA quality grade. Carcasses identified as greater than 30 MOA through dentition are eligible for all USDA grades, with application of skeletal and lean characteristics factored in the determination, as currently described in the beef standards.

USDA is not proposing any changes to the requirements for carcasses exhibiting dark cutting lean, regardless of age verification method. Carcasses exhibiting dark cutting lean will be graded as currently described in the beef standards.

Proposed amendments to the beef standards are described below:

## **UNITED STATES STANDARDS FOR GRADES OF CARCASS BEEF**

### **54.104 – Application of standards for grades of carcass beef**

1. Amend 54.104 by revising paragraph (k) to read as follows:



(k) For steer, heifer, and cow beef, quality of the lean is evaluated by considering its marbling, color, and firmness as observed in a cut surface, in relation to carcass evidences of maturity. The maturity of the carcass is determined through one of three methods:

(1) Dentition as monitored by the Food Safety and Inspection Service (FSIS). Carcasses determined to be less than 30 months of age (MOA) will be classified as A-maturity, and with the exception of dark cutting lean characteristics, the final quality grade will be determined by the degree of marbling. Any carcasses under 30 MOA exhibiting advanced skeletal maturity traits (as described for D- and E-maturity) will not be eligible for the Prime, Choice, Select, or Standard grades and will be graded according to their skeletal, lean, and marbling traits accordingly;

(2) Documentation of age as verified through USDA-approved programs and by FSIS at the slaughter facility. Carcasses determined to be less than 30 MOA by age verification will be classified as A-maturity and, with the exception of dark cutting lean characteristics, the final quality grade will be determined by the degree of marbling. Any carcasses under 30 MOA exhibiting advanced skeletal maturity traits (as described for D- and E-maturity) will not be eligible for the Prime, Choice, Select, or Standard grades and will be graded according to their skeletal, lean, and marbling traits accordingly; or

(3) Through evaluation of the size, shape, and ossification of the bones and cartilages, especially the split chine bones, and the color and texture of the lean flesh. Carcasses determined to be greater than 30 MOA will be eligible for

all quality grade classifications with the final quality grade being determined by the evaluation of the degree of marbling and any adjustment factors based on advanced skeletal maturity characteristics. In the split chine bones, ossification changes occur at an earlier stage of maturity in the posterior portion of the vertebral column (sacral vertebrae) and at progressively later stages of maturity in the lumbar and thoracic vertebrae. The ossification changes that occur in the cartilages on the ends of the split thoracic vertebrae are especially useful in evaluating maturity and these vertebrae are referred to frequently in the standards. Unless otherwise specified in the standards, whenever reference is made to the ossification of cartilages on the thoracic vertebrae, this shall be construed to refer to the cartilages attached to the thoracic vertebrae at the posterior end of the forequarter. The size and shape of the rib bones are also important considerations in evaluating differences in maturity. In the very youngest carcasses considered as “beef,” the cartilages on the ends of the chine bones show no ossification, cartilage is evident on all of the vertebrae of the spinal column, and the sacral vertebrae show distinct separation. In addition, the split vertebrae usually are soft and porous and very red in color. In such carcasses, the rib bones have only a slight tendency toward flatness. In progressively more mature carcasses, ossification changes become evident first in the bones and cartilages of the sacral vertebrae, then in the lumbar vertebrae, and still later in the thoracic vertebrae. In beef that is very advanced in maturity, all the split vertebrae will be devoid of red color and very hard and flinty, and the cartilages on the ends of all the vertebrae will be entirely ossified. Likewise, with advancing maturity, the rib bones will

become progressively wider and flatter, which is shown in very mature beef  
whose ribs will be very wide and flat.

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**Authority: 7 U.S.C. 1621-1627.**

Dated: June 14, 2017

Bruce Summers  
Acting Administrator  
Agricultural Marketing Service

BILLING CODE 3410-02 P

[FR Doc. 2017-12647 Filed: 6/16/2017 8:45 am; Publication Date: 6/19/2017]